

focus

SE challenges in small companies.....

Adept: A Unified Assessment Method for Small Software Companies

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Adept combines two process assessment methods, one plan-based and one agile-based, without dictating which one to use. This makes the lightweight approach attractive for small software companies.

Limited in scale and resources, small software companies find software process improvement a major challenge. Early-stage software companies focus on time to market, innovation, and creativity¹ and thus often ignore SPI models such as CMM and CMMI, whose primary initial emphasis is on achieving stability and predictability.² So, to realize their business goals, small companies are increasingly attracted to agile methods, which promise shorter development schedules and greater delivery flexibility.

Software process assessment remains the best way for an organization to begin an SPI program. Assessments can highlight strengths and weaknesses in an organization's processes and thereby focus the SPI effort. However, to deal with resource limitations, small software companies need short, light assessments. Furthermore, because SSCs are using agile methods widely, these agile approaches must be incorporated into any potential process assessment method.

The Adept assessment method we've created takes into account the business realities facing SSCs. Adept combines the CMMI Class C appraisal guidelines³ and an adapted Agility/Discipline Assessment approach^{2,4} in a unified model. While we've generated promising results using each approach separately, our synthesis of these practices offers opportunities for real SPI gains in SSCs.

Process improvement in small Irish software companies

The Irish software industry is a key component of the national economy. According to Enterprise Ireland, a development agency for indigenous companies, at the end of 2004 more than 750 Irish-owned software businesses employed almost 12,000 people.⁵ However, the vast majority of these indigenous Irish software organizations are microfirms, with only 1.9 percent employing more than 100 people and more than 60 percent employing 10 or fewer.⁶

In a similar survey of 56 Irish software development organizations, the Centre for Software Process Technologies (CSPT) found that 71 percent of the surveyed companies were indigenous, with most employing fewer than 20 people.⁷

Demand for lighter assessment methods

During the late 1990s, the SPIRE (Software Process Improvement in Regions of Europe) program⁸ reported positive experiences in applying the SPICE (Software Process Improvement and Capability Determination) model (www.sqi.gu.edu.au/spice) in Irish SSCs. These companies liked the ability to choose process areas that directly related to their business goals.

However, the CSPT survey⁷ found that 46 percent of respondents believed formal assessment methods were too cumbersome and expensive and that a less costly approach, such as Class C CMMI appraisal methods, was preferable.⁹ In addition, recent research indicates that indigenous Irish software companies still avoid formal process assessment because of the high cost and resources involved.¹⁰

Plan-driven process assessment

Plan-driven process assessment methods generally draw on either the ISO/IEC 15504 reference model¹¹ or the CMMI¹² model. An analysis by Alessandra Anacleto and her colleagues¹³ of lightweight methods for SSCs produced the following criteria for plan-driven assessment methods:

- low cost,
- detailed description of the assessment process,
- guidance for process selection,
- detailed definition of the assessment model,
- support for identifying risks and improvement suggestions,
- support for high-level process modeling,
- conformity with ISO/IEC 15504,
- no specific software engineering knowledge required from company representatives,
- tool support, and
- public availability.

The Express Process Appraisal method

The Express Process Appraisal⁹ method is an example of an Appraisal Requirements for CMMI (ARC) Class C-compliant method that is suited to organizations with little SPI experience. Researchers have used EPA to assess six process areas in six software development organizations.⁹ All the companies agreed, prior to beginning the assessments, that the following six process areas were applicable:

- Project Monitoring and Control,
- Project Planning,
- Requirements Management,
- Configuration Management,
- Process and Product Quality Assurance, and
- Measurement and Analysis.

The EPA method involved two assessment team members interviewing staff from the assessed companies (a separate interview for each process area). Normally, one hour was sufficient to cover each area, and all the companies appreciated that they could complete the on-site assessment in one day. During each interview session, one assessor led the questioning while the other recorded notes. Subsequently, both assessors reviewed their notes and discussed their findings.

The EPA method relies on information obtained from interviewing company personnel and performing limited cross-referencing checks. Therefore, it's important that the appropriate personnel are interviewed and that they answer the interview questions truthfully so that the findings will accurately reflect the company's strengths and weaknesses in each appraised process area. The findings report contains a list of recommendations that each company must prioritize into an action plan based on its goals and aspirations.

The EPA is attractive and cost-effective to small organizations because it requires only six person-days of internal staff time (and six person-days of external appraiser time). This factor has proved important to initiating SPI in small organizations. The method contributed to the Diagnosing stage in the IDEAL (Initiating, Diagnosing, Establishing, Acting, and Learning) model.¹⁴ This diagnosis provides an awareness of the issues that require resolution in order for the organization to improve. The organization can then prioritize these issues on the basis of its business goals.

Results using EPA

Figure 1 summarizes the results of the six companies' EPA assessments in the form of a score between 0 and 100 percent for five process areas.¹⁵ The Measurement and Analysis process area wasn't included in this chart because most of the companies couldn't answer questions relating to it.

Each bar in the chart measures on average how well the six companies met that process

**More than
60 percent
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Irish software
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people.**

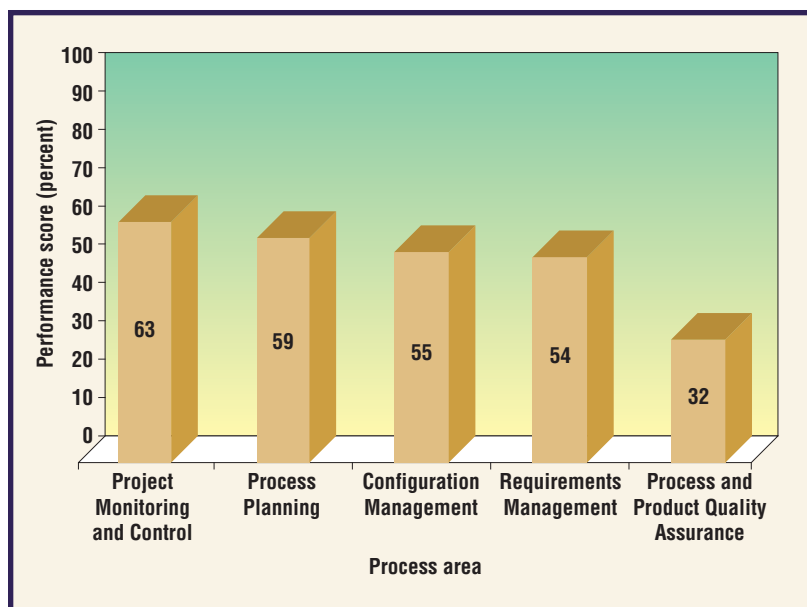


Figure 1. Assessment results using the Express Process Appraisal method.

area's specific goals. A score of 0 percent would mean that none of the companies supported that process area's specific goals at all, whereas a score of 100 percent would mean that all the companies fully supported that process area's goals. Researchers in the CSPT obtained the scores by rating the answers to questions on each specific practice as "not practiced" (value 0), "partially practiced" (0.33), "largely practiced" (0.67), and "fully practiced" (1.0). They assessed each goal by asking one to five questions related to the specific practices within that goal. They then averaged each company's scores to give a single score for each process area's specific goals.

This study ranked the six process areas from the strongest CMMI compliance to the weakest as follows:

- Project Monitoring and Control (PMC),
- Project Planning (PP),
- Configuration Management (CM),
- Requirements Management (REQM),
- Process and Product Quality Assurance (PPQA), and
- Measurement and Analysis (M&A).

The SEI reports the same ranking of process areas in terms of support (how well a company's practices support a goal) from its SCAMPI appraisals.¹⁶ The process-area profiles for the 18 organizations appraised at Maturity Level 1 indicate a very similar ranking in these six process areas (from highest to lowest): PMC; PP; REQM;

CM; M&A, and PPQA. This shows that the trends the CSPT observed in their small set of company assessments resemble those reported from SCAMPI appraisals.¹⁵

Agile methods and process assessment

Agile methods are empirical processes requiring frequent inspection and adaptive response. They're not easily assessed using ISO/IEC 15504 and CMMI, although we can map some methods such as Scrum and XP to ISO 9001¹⁷ and CMMI Levels 2 and 3.¹⁸ Jeff Sutherland¹⁹ claims that the parallel pipelining of Scrum sprints might enable CMMI Level 4 or 5 compliance. This suggests that it's possible to apply the lightweight process assessment methods we mentioned earlier in this article to organizations using an agile approach.

The Adapted Agility/Discipline method

Our aim was to have an efficient assessment, considering the limited time and resources available to SSCs, and to engage all team members. To achieve this, we kept each section of the assessment just detailed enough to be useful. AAD is based on Barry Boehm and Richard Turner's Agility/Discipline Assessment method.² They summarized the strengths and weaknesses of the agile and plan-driven methods using five critical factors: Personnel Ability, Criticality of Software, Team Size, Organizational Culture, and Requirements Churn per Month. On the basis of our initial experimentation, we also included a Customer Involvement factor. Many organizations felt that the culture factor wasn't helpful, so we replaced it with Team Distribution, which is a major challenge for SSCs.

Here, we report results from two contrasting companies. The first organization (OrgA) develops a range of Internet-based software solutions and employs five software developers. The second organization (OrgB) develops customer relationship management solutions, employs 20 developers, and is ISO 9001 accredited. OrgA wasn't using any clear, purposeful process but wanted to begin SPI; OrgB wanted to investigate an agile approach.

All team members in OrgA believed that the primary risk they face is uninvolved off-site customers. The goal was to turn their customers into off-site agile believers (which we'll call Off-AB). Off-AB customers work well with Internet-based products because of the straight-

OrgA has experienced a common occurrence for SSCs: a customer desiring new functionality at product handover. In this circumstance, OrgA had to do further product development within the original budget. The subsequent work led to unplanned, badly paced software development and schedule delay. The contractual arrangement meant that OrgA received delayed payment. Such scenarios leave SSCs vulnerable. The item OrgA rated most risky using an agile approach was personnel turnover. The practices implemented in OrgA are discussed elsewhere.⁴

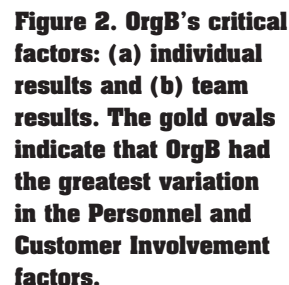
Figure 2a shows the risk factors plotted for OrgB covering nine projects and 19 employees. The Personnel and Customer Involvement factors show the greatest variation, as shown by the gold ovals. Even though these factors are rated subjectively, they're central to an organization's success. The other factors display greater uniformity and can initially be left unaddressed by OrgB while it addresses Personnel and Customer Involvement factors.

When looking at the critical factors team by team, we noted interesting differences. Figure 2b shows that on one specific project, consisting of a team of three people, we found differences regarding Personnel and Customer Involvement. Analyzing these variations is important because it can uncover genuine misconceptions affecting team performance. Often, with greater unanimity, teams can improve their performance.

When we collate the risk ratings, we can get a general view of the environmental, agile, and plan-driven risks in OrgB, as figure 3a shows. All the risk categories appear to be similar, with only a slight downward move from agile to plan-driven risks. The red line shows that only one person rated the agile risks as greater than the plan-driven risks. In OrgB's case, this suggests suitability for both agile and plan-driven approaches. We can further analyze each risk category team by team, as figure 3b shows.

We aim to keep both the agile overview and project postmortem meetings for team members to one hour each. At these meetings, we describe the criticality factors and risk ratings and then give each team member a short, six-page form to read and complete where appropriate:

Page 1. Explanation of assessment parts and applicable project table



Page 2. Explanation of critical-factor categories

Page 3. Example diagram and interpretation

Page 4. Blank diagram for team members to plot risk factors, and space for any clarifying comments

Page 5. Table of risk ratings

Page 6. Space for further comments

Approximately 50 people have filled out the

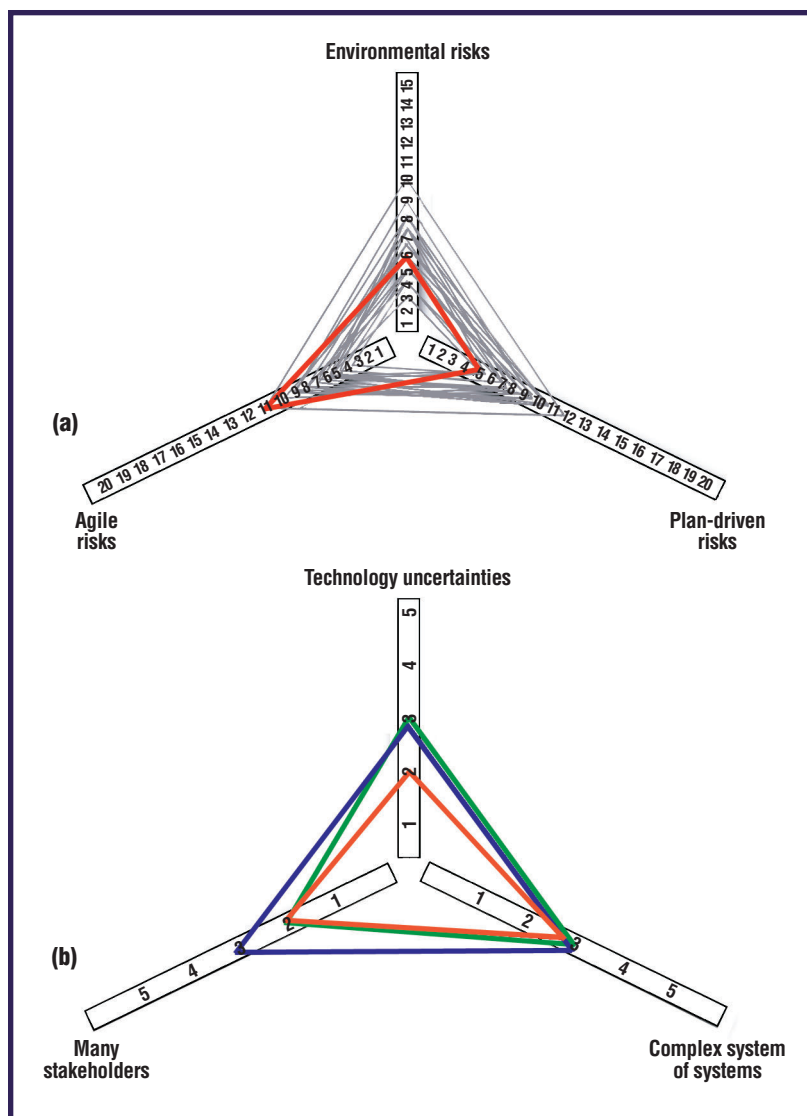


Figure 3. Visualizing OrgB risk ratings: (a) individual results and (b) team results. The colored triangles in 3b represent the three people who plotted the risks.

assessment form, taking on average around 45 minutes to complete it.

After the team has finished, we collate the results and produce a visual presentation for the whole organization, lasting no longer than two hours. At this stage, the organization is free to end its involvement with us. However, if the organization chooses to continue, we develop a risk mitigation strategy. This stage isn't time-boxed, because each strategy is unique to the organization concerned.

The AAD assessment provides a minimally intrusive yet visually stimulating way to get all staff members thinking about SPI. It's suited to SPI initiatives in three organizational situations: those not using any clear process, those wanting to try an agile approach, and those wanting to improve their process regardless of SPI model.

When we examine the individual critical factors, the similarities and differences within the same team become evident. The teams with the biggest differences often struggle to perform at an optimum level. When we present the results visually, the team members often agree with our findings and subsequently resolve their differences.

Unifying the EPA and AAD approaches

Given the successes of EPA and AAD, companies might have to choose which method to adopt. We've resolved this for our work using a new assessment method called Adept.

Background

Adept is based on the EPA method's structure but differs in several ways. It

- includes AAD;
- doesn't highlight either CMMI or ISO/IEC 15504, focusing on improvement rather than certification;
- is based on relevant process areas from CMMI and includes input from ISO/IEC 15504;
- enables the development of an SPI path based on a company's business goals; and
- involves revisiting the company's SPI program after three months.

Adept fulfills most of the criteria that Anacleto and her colleagues¹³ outlined; we considered it unnecessary to support high-level process modeling, or to make it publicly available. Adept also integrates the ARC 1.1 requirements for a CMMI Class C method. We developed questions from both the CMMI and ISO/IEC 15504 covering 12 process areas, and we ask additional, nonscripted questions as an interview proceeds. Adept also relies on Boehm and Turner's risk items and critical factors, which now include Customer Involvement and Team Distribution. The analysis of results contains graphs representing individual teams and all teams across the organization.

A key decision in developing Adept was to identify the process areas most applicable to the Irish SSCs; the ones we included are based on previous research results.^{9,15} We chose six of the seven process areas associated with CMMI Maturity Level 2 (REQM, CM, PP, PMC, M&A, and PPQA) because they constitute the engineering management basis of an organization and the foundation upon which an efficient soft-

ware company is based. We omitted the seventh area, Supplier Agreement Management, because previous research indicated it wouldn't benefit small Irish software companies as much as the other areas.⁹ Furthermore, omitting one process area ensures that companies can't claim Level 2 compliance even if no issues or weaknesses are discovered in the process areas appraised.

After investigating the CMMI Level 3 process areas, we considered six of the 14 applicable: Risk Management, Technical Solution, Verification, Validation, Requirements Development, and Product Integration. So, we included an assessment component in Adept for each of these. The process areas listed at CMMI Levels 4 and 5 would be of less benefit to companies that have little SPI experience. As a result, Adept enables assessment just in the 12 selected CMMI Levels 2 and 3 process areas.

Four of the areas—Requirements Management, Configuration Management, Project Planning, and Project Monitoring and Control—are mandatory because, based on EPA assessment results and SEI empirical data,¹⁶ they are fundamental to any software company's success. We also chose these mandatory process areas on the basis of three factors' overlap: those considered to be the foundation process areas of the CMMI model, those chosen in CSPT research to be most applicable to small companies,¹⁵ and those supported by other previous research.^{9,10}

To reduce the cost and time associated with the assessment, we restrict on-site interviewing to one day. We also limit Adept to six process areas because this is the maximum that can be covered reasonably in one day.⁹ So, in addition to being assessed in the four mandatory areas, companies can choose two more. On the basis of previous research into process areas' applicability to SSCs,⁹ we advise companies against selecting M&A or PPQA unless these are directly linked to their business goals.

Carrying out an Adept assessment

Two assessors can perform an Adept assessment. Figure 4 illustrates an assessment's eight stages:

- Stage 1: *Develop assessment schedule and receive site briefing*. The assessment team and the software company hold a preliminary meeting. All staff members receive the AAD forms for completion and incorporation into Stage 5.

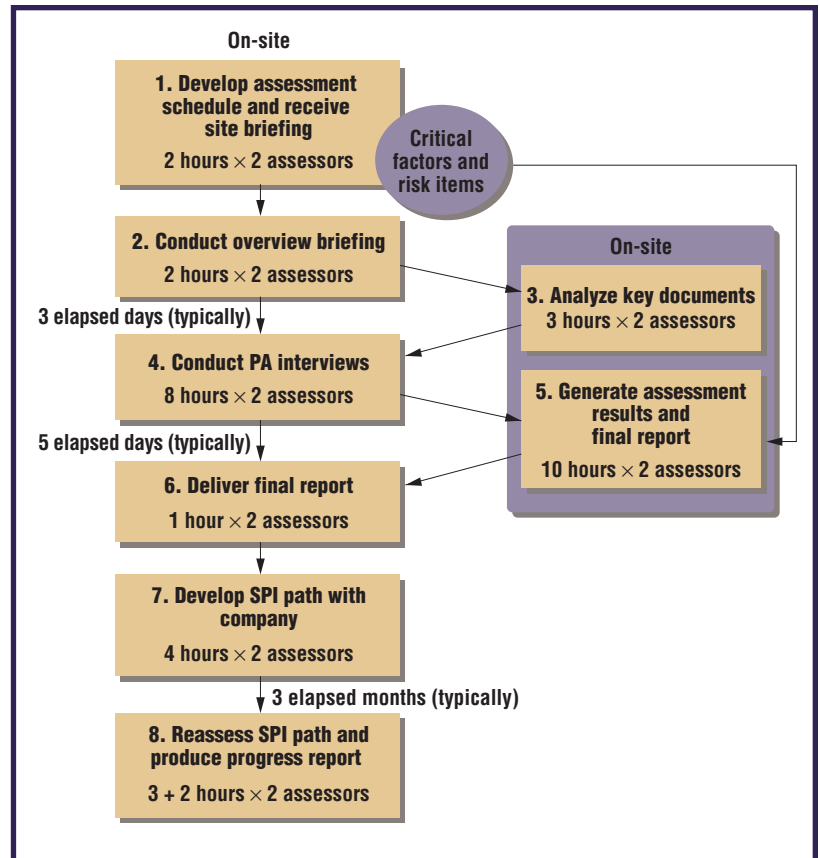


Figure 4. The Adept assessment process's eight stages.

- Stage 2: *Conduct overview briefing*. The lead assessor gives an overview of Adept for the company's members who will be involved in subsequent stages.
- Stage 3: *Analyze software documentation*. The assessment team provides a brief insight into project documentation.
- Stage 4: *Conduct process-area interviews*. The assessors interview key staff members across the six chosen process areas.
- Stage 5: *Generate assessment results and create a report*. The assessors produce a findings report by reviewing the data obtained for each process area and from the AAD assessment. This report contains a set of strengths, issues, and suggested actions for each process area evaluated.
- Stage 6: *Deliver the findings report*. The assessors present the report to the staff who participated in the interviews.
- Stage 7: *Develop an SPI path with the company*. The assessors collaborate with staff to develop an SPI roadmap that focuses on the company's business goals.
- Stage 8: *Review the SPI path and produce a final report*. The assessors revisit the com-

We limit Adept to six process areas because this is the maximum that can be reasonably covered in one day.

pany approximately three months after stage 7 is completed and review progress against the roadmap. This stage's outcome is an updated SPI path and a final report detailing the progress that has been accomplished along with additional recommendations.

Overall, Adept requires approximately 68 person-hours of assessor time and 48 person-hours of the appraised organization's time. Ideally, Stages 1 through 7 are completed over two weeks, with Stage 8 happening approximately three months later.


The Irish software industry needs to educate its managers in an SPI and quality agenda. Adept's incorporation of EPA and AAD helps in several ways. First, marketing EPA and AAD has raised awareness of SPI. Also, the assessments we performed raised the education level of the assessed organizations' employees. Additionally, the results provided a roadmap for SPI in the assessed organizations, with some now following a clear SPI path.

Recognizing the need to give companies the widest impartial choice of SPI options, Adept enables a focused and tailored improvement path based on a company's operational context and business goals. This approach doesn't mandate a specific SPI model in advance of company assessment; any SPI initiative is exclusively tailored to the particular company. Crucially, Adept aims to create a sustainable SPI culture in SSCs and bring ongoing and lasting benefit to the companies concerned.

We've also designed Adept to support the objectives of Enterprise Ireland and Momentum (the Northern Ireland Federation for Information and Communication Technology). These organizations ask that assessment models for small companies recognize that

- improvement is more important than certification,
- the time to prepare and perform the assessment should be minimal, and
- the assessment method should let companies select process areas that are most relevant to their business goals.

Tying in with the demands of Enterprise Ireland and Momentum means that Adept

helps these agencies meet their goals. The two agencies are developing strategies and programs, and making funding support available, to encourage SSCs to engage in SPI. We're discussing with EI and Momentum how to best incorporate Adept within these efforts. We're also about to embark on a pilot scheme that will lead to several Adept assessments in Irish SSCs in the near future. We believe Adept will be applicable internationally but expect it to need refinements following the pilot and prior to a wider rollout. 

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